CERTIFICATE

I, Thomas Kitzhofer, of Manzingerweg 7, 81241 München, Germany, declare that I am conversant with the German and English languages, and that to the best of my knowledge and belief the accompanying text is a true translation of the priority document issued by the German Patent and Trade Mark Office on 11 December 2001, for Serial No. 201 04 043.3

Signed this 2nd day of August 2005

FEDERAL REPUBLIC OF GERMANY

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Certificate of Priority Relating to the Filing of a Utility Model Application

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The attached documents are a correct and true copy of the original documents of this patent application.

Munich, dated 11 December 2001
German Patent and Trademark Office
The President
By:

[seal of the German Patent and Trademark Office]

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Device for Damping Vibrations in a Steering Wheel

The invention relates to a device for the damping of vibrations in a steering wheel, with a damping means and an amortization mass connected with the damping means.

Vibrations of the steering wheel are experienced as disturbing by the driver. The vibrating of a steering wheel is influenced by various parameters. The longitudinal resilience of the rear axle suspension converts the vibrations, introduced as a result of an imbalance of the wheels on the rear axle, to a horizontal vibration of the bodywork and hence to a vertical vibration of the steering wheel. Engine vibrations, specifically in diesel vehicles, often lead in idling to vibrations on the steering wheel. In order to damp the vibrations introduced into a steering wheel, often a force directed in opposition to the direction of movement is applied. For this, spring mass systems are used, which are also known as vibration dampers.

Vibration dampers are known which consist of metal masses mounted in rubber elastic, these vibration dampers being coordinated with particular frequencies. Generally, such vibration dampers are fastened to the steering wheel hub. As attenuation mass also a gas generator of a gas bag module arranged in the steering wheel can be used, or the gas bag module itself is utilized for vibration damping.

Thus, for example in the EP-A 0 827 878 the damping of the steering wheel vibrations takes place via springs arranged concentrically around the gas bag module, which springs rest on the steering wheel body.

A substantial disadvantage in the described vibration dampers lies in that they are only coordinated with one frequency. Owing to the various influences of the path which is traveled and the changeable engine vibrations with different rotation rates, however, the frequency of the steering wheel vibration changes continuously. A majority of the steering wheel vibrations therefore remains undamped.

It is an object of the invention to improve the vibration damping of a steering wheel.

This is achieved in a generic device for damping vibrations in a steering wheel in that an electrical control unit, coupled with the damping means, is provided, which can alter the mechanical vibration characteristics of the device such that different vibration frequencies can be damped. By means of the mechanical vibration characteristics of the device, its vibration frequency is influenced, so that the vibration frequency of the device can be adapted to the present vibration frequency of the steering wheel, in order for example to achieve a resonance amortization. The device, hereinafter also known as a vibration damper, can therefore be coordinated in a flexible manner to the actual present vibration frequency of the steering wheel, so that chronologically variably different vibrations can be damped.

In a preferred embodiment of the invention, the damping means is designed such that the mechanical vibration characteristics of the device can be altered by the supply of electrical energy to the damping means. The supply of electrical energy can take place by producing a current flow, by applying a voltage or by applying an electric field. The supply of electrical energy can be controlled in a simple and flexible manner by the electric control unit, so that the vibration damper can be adjusted quickly and continuously in its vibration frequency.

Preferably, through coupling with a sensor, the control unit receives data regarding present vibrations of the steering wheel, so that the vibration frequency

of the vibration damper can always be coordinated with the present vibration frequency of the steering wheel.

The change to the mechanical vibration characteristics is preferably achieved in that the damping means contains a material which with the supply of electrical energy alters its mechanical characteristics. In this way, mechanically adjustable devices can be dispensed with, which simplifies the construction of the device and increases its lifespan. The material is preferably an electrically conductive elastomer. The elastomer advantageously contains electrically conductive particles, e.g. soot or metal particles. Particularly advantageously, polarizable particles can be used. Through a flow of current through the elastomer, the position of such particles can be altered, with site interchange reactions occurring, so that the mechanical characteristics of the polymer matrix can be influenced.

In another preferred embodiment of the invention, the material is an electrorheological fluid. The viscosity of such fluids can be influenced in a wide range by means of the application of an electrical field, whereby the vibration frequency of the vibration damper can be altered in a very flexible manner.

In a further preferred embodiment of the invention, the damping means contains a bimetal strip. With a through-flow of current, the bimetal strip becomes heated and alters its curvature and hence its vibration frequency. Bimetal strips react very quickly to a temperature change, so that through a through-flow of current, a rapid and precise coordination of the vibration frequency can be achieved.

In a further preferred embodiment of the invention, the damping means contains a damping body and a magnet surrounding the damping body. The magnet is preferably an electromagnet.

The material of the damping body can be an electrically conductive elastomer. The alteration to the vibration characteristics can in this case either take place in that the flow of current is altered in the surrounding electromagnet or by the flow of current being altered within the preferably annular damping body.

In an advantageous further development of the invention, the damping body contains a magnetorheological fluid. The viscosity of such a fluid alters according to the strength of the magnetic field in which the fluid is situated. In this way, by means of the alteration to the flow of current in the electromagnet surrounding the damping body, a rapid and simple alteration to the vibration frequency of the device can be achieved.

Preferably, a gas generator of a gas bag module arranged in the steering wheel fulfils the task of attenuation mass. In this way, no further mass has to be arranged in the steering wheel, whereby the weight of the steering wheel would be increased unnecessarily.

Further advantages and features of the invention will be apparent from the following description of several example embodiments, with reference to the enclosed drawings, in which:

- Figure 1 shows a section through a steering wheel with a device according to the invention in accordance with a first and a second embodiment according to the right or respectively left half of the drawing; and

- Figure 2 shows a section through a steering wheel with a device according to the invention in accordance with a third embodiment.

Figure 1 shows a steering wheel 10, which is fastened in a known manner to a steering wheel column 12. Inside the steering wheel 10 a gas bag module 14 is arranged with a gas bag 16 and a gas generator 18. The gas generator 18 forms an attenuation mass of a vibration damper 20, which in addition to the attenuation mass 18 has a damping means 22 connected with the steering wheel skeleton 11 and which forms a device for the damping of vibrations in a steering wheel.

The damping means 22 contains a damping body 24 which is connected with a metal sheet 25 fastened to the steering wheel skeleton 11 and with the attenuation mass 18. The vibration damper 20 contains in addition an electrical control unit 26 which is coupled with the damping means 22.

The control unit 26 is preferably connected with an acceleration sensor 28, which is arranged on the steering column 12 and measures its vibrations and transmits these data to the control unit 26.

The vibration damper 20 serves principally for the damping of vertical steering wheel vibrations, in the direction of the axis V illustrated in the drawing, but also brings about a reduction to the vibration components in the direction of the illustrated axis H.

In a first embodiment of the invention (right-hand half of the drawing), the damping body 24 contains an electrically conductive elastomer, which contains for example soot particles or metal particles which may advantageously be magnetically polarizable. The damping body 24 is preferably ring-shaped. The damping body 24 is connected with the control unit 26 via leads 30.

The elastomer is selected such that on application of an electrical voltage to the damping body 24 or on setting of an electrical current flow through the damping body 24, the hardness and hence the vibration characteristics of the damping body 24 alter.

The setting of the supply of electrical energy can take place on the basis of previously derived correlations.

The mode of operation of the vibration damper according to the first embodiment 20 is as follows. The acceleration sensor 28 on the steering wheel 12 measures the frequency of the vertical component of the steering wheel vibration. The control unit 26 receives these data from the acceleration sensor 28 and causes a corresponding supply of electrical energy in the form of current, voltage or an electrical field to the damping body 24. The elastomer material of the damping body 24 preferably changes its hardness under the influence of the electrical energy, so that the vibration characteristics of the damping body 24 alter. In this way, the vibration frequency of the vibration damper 20 can be coordinated exactly with the present vibration frequency of the steering wheel 10, so that for

example a resonance amortization is able to be achieved and the vibration amplitude of the steering wheel is reduced.

The necessary values for the supply of electrical energy are preferably determined in prior tests and are stored in the control unit 26.

In a second embodiment (left-hand half of the drawing), bimetal strips 32 are embedded into the damping body 24. Through a flow of current set by the control unit 26 through the damping body 24 or respectively the bimetal trips 32, the bimetal strips 32 are heated and change their curvature as a function of the temperature. Thereby, the inherent frequency of the damping body 24 can be adapted in order, as described above, to damp the steering wheel vibration.

The bimetal strips 32 do not have to be embedded in the damping body 24. In this case, however, it is important that the bimetal strips 32 are firmly connected both with the gas generator 18 and also with the steering wheel skeleton 11.

In another embodiment of the invention, provision is made that the damping body 24 contains an electrorheological fluid. With such fluids, by the application of an electrical field the viscosity can be altered within a wide range in a short time. By application of a voltage to the damping body 24, accordingly its vibration frequency can be set to the respectively necessary value.

The vibration damper 20' of the steering wheel 10 illustrated in Figure 2 differs from that shown in Figure 1 in that the damping means 22 contains a damping body 24 and a magnet 34 arranged around the damping body 24.

In this embodiment of the invention, the magnet 34 is an electromagnet, whereas the damping body 24 preferably contains a ring of an electrically conductive elastomer. The control unit 26 alters the flow of current through the electromagnet as a function of the present vibration of the steering wheel and hence alters the electromagnetic field prevailing in its interior. The currents thus induced in the damping body 24 alter the vibration frequency of the vibration

damper 20', so that, adapted to the present vibration of the steering wheel, different frequencies can be damped.

In a further embodiment of the invention, the field intensity of the magnetic field of the magnet 34 is not altered, but rather the current flow through the elastomer ring of the damping body 24. The magnetic field thus generated and its alteration act on the vibration characteristics of the vibration damper 20', so that an adapted damping can be achieved. In this embodiment, the magnet 34 can also be a permanent magnet.

In another embodiment of the invention, the damping body 24 contains a magnetorheological fluid. Similar to the electrorheological fluids described above, such fluids alter their viscosity as a function of the magnetic field in which they are situated. By means of an alteration to the field of the electromagnet 34, the vibration frequency of the vibration damper 20' can thus be adjusted.

The control unit 26 can also be supplied with data from sources other than the acceleration sensor 28. The control unit 26 can in addition be designed to release the gas bag module.

Claims

1. A device for the damping of vibrations in a steering wheel, comprising a damping means (22) and with an attenuation mass (18) connected with the damping means (22), characterized in that an electrical control unit (26) is provided, coupled with the damping means (22), which control unit (26) can alter the mechanical vibration characteristics of the device (20; 20') such that different vibration frequencies can be damped.

2. The device according to Claim 1, characterized in that the damping means (22) is designed such that the mechanical vibration characteristics of the device (20; 20') can be altered by the supply of electrical energy to the damping means (22).

3. The device according to any of the preceding claims, characterized in that a sensor (28) is provided, through which the control unit (26) receives data regarding vibrations of the steering wheel (10).

4. The device according to any of Claims 2 and 3, characterized in that the damping means (22) contains a material which alters its mechanical characteristics with the supply of electrical energy.

5. The device according to Claim 4, characterized in that the material is an electrically conductive elastomer.

6. The device according to Claim 4, characterized in that the material is an electrorheological fluid.

7. The device according to any of Claims 1 to 4, characterized in that the damping means (22) contains a bimetal strip (32).

8. The device according to any of Claims 1 to 3, characterized in that the damping means (22) contains a damping body (24) and a magnet (34) surrounding the damping body (24).

9. The device according to Claim 8, characterized in that the magnet (34) is an electromagnet.

10. The device according to any of Claims 8 and 9, characterized in that the damping body (24) contains an electrically conductive elastomer.

11. The device according to any of Claims 8 and 9, characterized in that the damping body (24) contains a magnetorheological fluid.

12. The device according to any of the preceding claims, characterized in that the attenuation mass is a gas generator (18).

Fig. 1

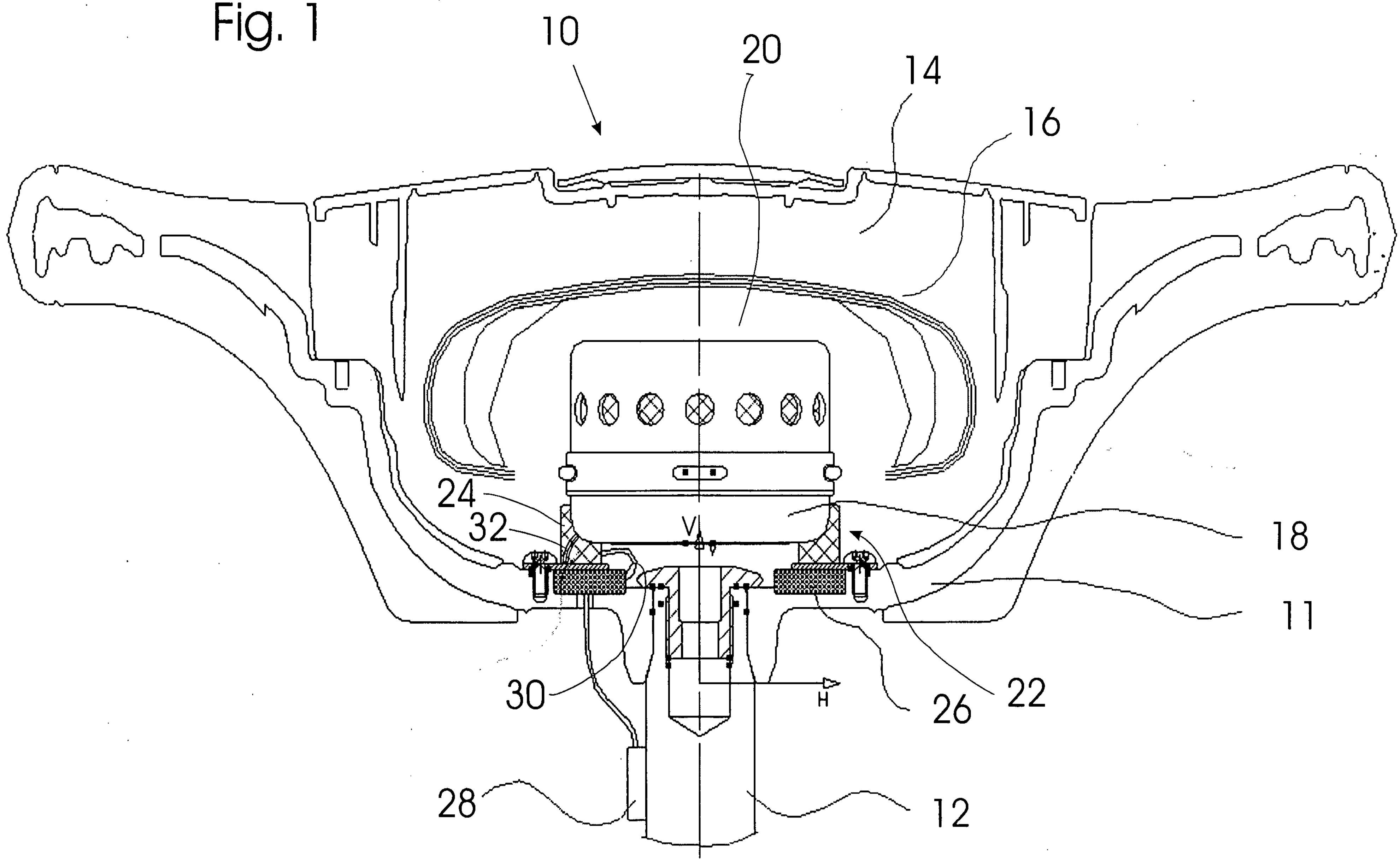

Fig. 2